

REMARKS

The Office action mailed 7 February 2006 and Advisory action mailed 14 April 2006, have been received and the contents carefully noted. The pending claims, claims 1-29, were rejected. By this amendment, claims 1 and 18-20 have been amended. Support may be found in the specification and the claims as originally filed. No statutory new matter has been added. Therefore, reconsideration and entry of the claims as amended are respectfully requested.

In addition to the remarks filed 8 March 2006, which are herein incorporated by reference, Applicants submit the following:

Background of Prosecution

After receiving the unexpected Advisory action mailed 14 April 2006, Applicants' representative called Examiner Keaney and discovered she is no longer under the employ of the U.S. Patent & Trademark Office (USPTO). Applicants' representative then called the Examiner's supervisor to discuss the Advisory action.

The Supervisory Patent Examiner (SPE) noted that Examiner Keaney intended on contacting the undersigned by ran out of time before leaving the USPTO. The SPE indicated that the claims were not allowable because the claims did not positively recite the solubilities of the layers themselves. The SPE recommended filing a Request for Continued Examination (RCE) with claim amendments.

Claim Amendments and the Claimed Invention

Applicants have amended the claims to positively recite the solubilities of the layers in the multilayer PQD-LED and the solubilities of the quantum dots in the layers.

In the Advisory action, the Examiner deemed that the specification provides written description support for the organic soluble layers to have non-polar properties. Consequently, the specification provides written description support for "non-polar solvent soluble layers".

Applicants respectfully submit that the claims are directed to a multilayer PQD-LED comprising at least one *aqueous solvent soluble* quantum dot layer of *aqueous solvent soluble*

quantum dots between a first *non-polar solvent soluble* polymer layer and a second *non-polar solvent soluble* layer which is a spun coat polymer layer or a spun coat organic molecule layer.

The multilayer PQD-LED as recited in claim 1, comprises an *aqueous solvent soluble* quantum dot layer of aqueous soluble quantum dots having a *spun coated non-polar solvent soluble* layer thereon. Since the adjacent layers are of different solubilities, the aqueous soluble QDs layer are not miscible/soluble in the non-polar solvent soluble layer spun coated thereon. Consequently, the layer of QDs is uniform and the QDs do not disperse into or mix with the adjacent polymer/organic layers. Thus, the spun coat layers of the claimed invention are different from the prior art in that the spun coat layers are uniform and do not have diffusive boundaries, i.e. mixing between adjacent layers.

The multilayer PQD-LED as recited in claim 18 comprises more than one quantum dot layer between the first non-polar solvent soluble polymer layer and the second non-polar solvent soluble layer and the aqueous solvent soluble quantum dot layers of aqueous solvent soluble quantum dots alternate with non-polar solvent soluble quantum dot layers of non-polar solvent soluble quantum dots. The different solubilities of the QD layers and the QDs allows a subsequent layer to be evenly spun directly upon the preceding layer, e.g. a non-polar solvent soluble QD layer of non-polar solvent QDs spun coated on an aqueous solvent soluble QD layer of aqueous solvent soluble QDs. Since the adjacent layers are of different solubilities, the QDs in one layer are not miscible or soluble in the adjacent layer. As a result, there is no observable mixing of the different QDs in the adjacent layers.

Rejection under 35 U.S.C. 102(e)

In the Office action of 7 March 2006, the Examiner maintained the rejection of claims 1-3, 5-10, 12, 16, 17-21, and 23-26 under 35 U.S.C. 102(e) as being anticipated by Jain et al. (US Patent No. 6,797,412). The Examiner also maintained the rejection of claims 1-3, 5, 6, 12, 13, 16, 17, and 23-26 under 35 U.S.C. 102(e) as being anticipated by Miller et al. (U.S. Patent No. 6,803,719).

Applicants respectfully submit that nowhere does the cited prior art teach or suggest spin coating alternating layers of different solubilities. Specifically, nowhere does the prior art teach or suggest spin coating a non-aqueous soluble material on top of an aqueous solvent soluble layer

of aqueous solvent soluble quantum dots. Instead the prior art (1) spins layers of similar solubilities on top of each other, e.g. a non-polar solvent soluble layer on top of another non-polar solvent soluble layer which results in mixing or diffusion or complete washing off of the layer between the layers, which results in less discrete layers in the multilayer PQD-LED or (2) “grows” an non-polar solvent soluble layer on top of the aqueous solvent soluble layer of aqueous solvent soluble quantum dots.

Jain et al.

Jain et al. does not disclose that the layer on the QD layer is a *spin coat* layer. Instead, Jain discloses *growing* a thin layer of the *organic* (non-polar organic soluble) material on top of the QD layer. In Jain et al., “grown” likely indicates “thermally evaporated”. Thermal evaporation is a high temperature process that is not suitable for depositing a layer on a large surface. Further, thermal evaporation is limited to organic molecules. Jain et al. does not specifically teach that the QDs are aqueous solvent soluble or functionalized to be aqueous soluble. Thus, the QDs may be soluble in non-polar solvents. Since the QDs of Jain et al. may be soluble in non-polar solvents, Jain et al. does not specifically teach or suggest spinning a non-aqueous soluble layer on top of an aqueous soluble QD layer as spinning a polymer/organic molecule layer on top of the QD layer is problematic since the QD layer would dissolve by and mix with the non-polar solvents. Thus, Jain et al. does not teach or suggest a *spin coat non-aqueous solvent soluble* layer deposited on an *aqueous solvent soluble* quantum dot layer as recited in claim 1.

Further, Jain et al. does not teach or suggest an aqueous soluble QD layer on top of a *polymer layer*. Instead, Jain et al. discloses a QD layer on an *inorganic semiconductor layer*. See e.g. col. 6, lines 1-9. This inorganic semiconductor layer of Jain et al. is not even equivalent to the polymer layer of the claimed invention. In fact, the inorganic semiconductor layer of Jain et al. makes the resulting LED inflexible and rigid, which is unlike the present invention. Consequently Jain et al. does not teach or suggest the invention of claim 1.

Although Jain et al. suggests a LED device having a plurality of adjacent QD layers in the figures, nowhere does Jain et al. teach or suggest that the QD layers have different solubilities

such that each layer may be spun coated without having an effect on the preceding layer.

Therefore, Jain et al. does not teach or suggest the invention of claim 18.

Since Jain et al. does not disclose (1) an *aqueous solvent soluble* quantum dot layer having (2) a *spun coat non-polar* solvent soluble layer deposited thereon, Jain et al. does not anticipate the claimed invention. Therefore, the rejection under 35 U.S.C. 102(e) should properly be withdrawn.

Miller et al.

The Examiner deemed that Miller et al. discloses a multilayer polymer quantum dot light emitting diode comprising at least one quantum dot layer between a first polymer layer and a second polymer layer.

Applicants respectfully submit that like Jain et al., Miller et al. does not disclose a *spun coat* non-aqueous layer deposited on an *aqueous solvent soluble* quantum dot layer of aqueous solvent soluble QDs. Specifically, the quantum dots in Miller et al. are embedded in an insulating polymer matrix. Thus, the QDs of Miller et al. are not aqueous soluble. In fact, the Examiner noted that Miller et al. does not teach or suggest *hydrophilic* (water loving = aqueous soluble) QDs. Thus, the QD layer of Miller et al. is not an *aqueous soluble* QD layer. Miller et al. does not teach or suggest an *aqueous solvent soluble* QD layer of aqueous solvent soluble QDs.

Further, the LED of Miller et al. is not the same as the electrically driven LED device of the present invention. Specifically, due to the insulating matrix, the design of Miller et al. is not even an electrically driven LED device. Instead, the device of Miller et al. is a light driven LED wherein another light source is necessary to produce light. Thus, the light driven LED device of Miller et al. does not anticipate the electrically driven LED device of the present invention.

Applicants also submit that Miller et al. does not disclose a *spun coat non-polar solvent soluble* polymer or organic molecule layer on top of an aqueous solvent soluble QD layer. In fact, as discussed above, spinning a polymer layer on top of the QDs embedded *polymer* layer would result in mixing between the two layers because of the similar solubilities. Consequently, Miller et al. does not teach or suggest a *spun coat non-polar solvent soluble layer* such as a polymer or organic molecule layer on top of an aqueous solvent soluble QD layer.

Since Miller et al. does not teach or suggest (1) an *aqueous solvent soluble* QD layer having (2) a *spun coat non-polar solvent soluble* polymer or organic molecule layer on top of the QD layer, Miller et al. does not anticipate the claimed invention. Therefore, the rejection under 35 U.S.C. 102(e) should properly be withdrawn.

Rejection under 35 U.S.C. 103(a)

The Examiner maintained the claim rejections under 35 U.S.C. 103(a) as being unpatentable over Jain or Miller and further in view of Coombs et al. (U.S. Patent No. 6,572,784) and in view of Matsuo et al. (U.S. Patent No. 6,391,482), Bawendi et al. (U.S. Patent No. 6,444,143), or Dumbrow et al. (U.S. Patent No. 6,475,364).

As explained above, the claimed invention is directed to a multilayer polymer-quantum dot light emitting diode comprising at least one (1) *aqueous solvent soluble* quantum dot layer of aqueous solvent soluble QDs between a first polymer layer and (2) a non-polar solvent soluble layer which is a *spun coat* second polymer layer or a *spun coat* organic molecule layer. The various combinations of the prior art cited by the Examiner do not alleviate the deficiencies of Jain or Miller. None of the combinations discloses or suggests an *aqueous solvent soluble* quantum dot layer of aqueous solvent soluble QDs having a *spun coat non-polar solvent soluble layer*.

Therefore, the present invention as claimed is nonobvious and the rejection under 35 U.S.C. 103(a) should properly be withdrawn.

Request for Interview

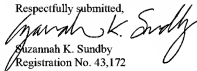
Applicants respectfully request either a telephonic or an in-person interview should there be any remaining issues.

CONCLUSION

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

It is not believed that extensions of time are required, beyond those that may otherwise be provided for in accompanying documents. However, in the event that additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. §1.136(a), and any fees required therefor are hereby authorized to be charged to **Deposit Account No. 02-4300**, Attorney Docket No. **034044.028**.

Respectfully submitted,



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